Archimedes Principle

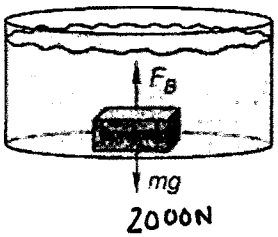
$F = mg$
$F = \rho V g$

ARCHIMEDES' PRINCIPLE

If any object is submerged or partially submerged in a liquid, the body is buoyed up by a force equal to the weight of the liquid displaced by the object.

1)

A 200-kg concrete block has a volume of 0.10 m^3. (a) Find the mass of water displaced by this block (ρ_{water} = 1000 kg/m^3). (b) Calculate the buoyancy force of the water. (c) Find the force needed to lift the block while it is submerged in water.

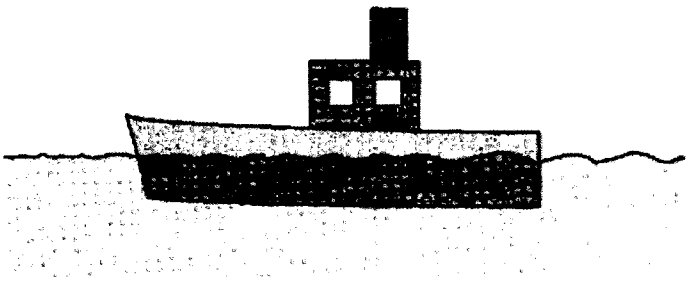


2000 kg/m³

a) $\rho = \frac{2000}{1} = \frac{2000 \text{ kg}}{1000}$

2)

A ship model floats in water as shown. The total volume of the model is 0.25 m^3, and 60 percent of this volume is submerged. (a) Find the mass of the water displaced. (b) Calculate the buoyancy force of the water. (c) Find the weight and mass of the ship.



a) $\rho \cdot V = m$
$m = 1000\ (60\% \text{ of } 0.25)$
$= 1000\ (.15)$
$= 150 \text{ kg}$

b) $B_F = mg$
$= 150(10)$
$= 1500 \text{N}$

c)

3)

The density of gasoline is 680 kilograms per cubic meter. A 48-kg ball whose volume is 0.085 m^3 is tethered to the bottom of a tank of gasoline, as shown. (a) Find the mass of gasoline displaced by this ball. (b) Calculate the buoyancy force of the gasoline. (c) Find the tension in the rope.

$\rho g h$

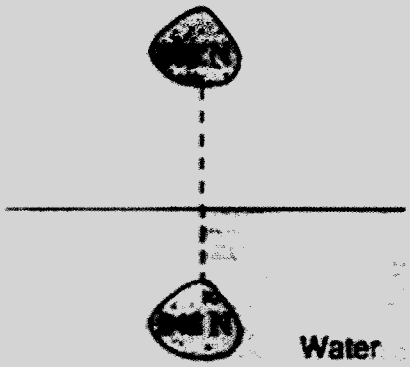
$\frac{m}{V} g h$ $\frac{mg}{V}$

$\frac{F}{A} = \frac{m}{V} g h$

$\frac{F \cdot \frac{h}{V}}{\frac{h}{V}} = \frac{m}{V} g h$

Archimedes Principle

4) A submerged stone weighs 248 N, but out of the water it weighs 688 N. (a) Calculate the buoyancy force of the water. (b) Find the mass of the water displaced. (c) Use this mass and $\rho_{water} = 1000\ kg/m^3$ to find the volume of the displaced water, which will tell you the volume of the stone.



5) A 200-kg homogeneous beam supports a mass of 100 kg, as shown. Find the tension in the wire. Then find the vertical and horizontal forces at the wall.